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CANCE CLAIMS 1-22

Add new claims

6. (NEW) A status discriminating apparatus for a human, an animal, or a machine, the apparatus comprising:

(a) an ultrasonic vibration detecting sensor comprising:

(i) a container main body;

(ii) a liquid packed tightly in the container main body; and

(iii) an ultrasonic vibrator arranged to transmit an ultrasonic wave into the liquid and to receive an ultrasonic wave reflected from the liquid surface, which serves to detect behavior of a detection object;

(b) an ultrasonic transmission and reception control device comprising:

(i) an ultrasonic transmitter/receiver;

(ii) a signal converter operably connected to the ultrasonic transmitter/receiver; and

(iii) a microcomputer operably connected to the signal converter so the microcomputer issues a transmission signal, at specific time intervals, to the ultrasonic vibration detecting sensor, and the microcomputer receives a reception signal, at specific time intervals, from the ultrasonic detecting sensor, and wherein the

25. (New) A method according to Claim 24, wherein the sample has a source plane, and as the transmit signal propagates to the focal plane, the amplitude of said second harmonic component of the produced, distorted signal at half the distance between the source and focal planes is about twice the amplitude of said second harmonic component at the source plane.

26. (New) A method according to Claim 23, wherein said sample causes defocusing effects in said near field, and because of said relatively large gain in growth of the amplitude of the second harmonic component between the near field and the focal plane, only a fraction of said second harmonic component is defocused by said near field defocusing effects.

27. (New) A method according to Claim 25, further comprising the step of high pass filtering the received harmonic components of the reflected, distorted ultrasonic signal.

28. (New) A method according to Claim 27, wherein the high pass filtering step occurs before the digitizing step.

29. (New) A method according to Claim 23, wherein:

the generating step includes the step of using a phased array transducer-receiver unit to generate the transmit signal; and

the directing step includes the steps of

i) using the transducer-receiver unit to focus the transmit signal on a focal point in the sample, and

ii) using electrical circuitry in the transducer-receiver unit to move the focal point around the sample.

30. (New) A method of imaging a biological sample, comprising the steps of:

generating first and second ultrasonic transmit pulse signals at a fundamental frequency;

directing the first and second pulse signals into and along a propagation path in the sample, wherein the sample distorts the first and second pulse signals along the propagation path and thereby produces, respectively, first and second distorted ultrasonic signals including harmonic components at second and higher order harmonic frequencies of the fundamental frequency, and further wherein the sample also reflects the first and second distorted ultrasonic signals including said harmonic components therein;

receiving the harmonic components of the reflected first and second distorted ultrasonic signals;

digitizing the received first and second signals;

scaling the digital values obtained from the first signal;

subtracting the scaled digital values obtained from the first signal from the second signal to produce a resultant signal;

using a processor to process said resultant signal to produce an image principally from the received harmonic components of the reflected distorted ultrasonic signals; and

displaying said produced image.

31. (New) A method according to Claim 30, wherein the resultant signal is high pass filtered and transformed to a time domain to obtain an on-axis distortion imaging pulse.

32. (New) A method according to Claim 30, wherein the sample has a near field and a focal plane, and wherein the amplitudes of the second harmonic components of the distorted ultrasonic signals exhibit relatively large gains in growth from low near field values to significant focal plane amplitudes.

33. (New) A method according to Claim 32, wherein the sample has a source plane, and as the transmit pulse signals propagate to the focal plane, the amplitudes of said second harmonic components of the produced, distorted signals at half the distance between the source and focal planes is about twice the amplitudes of said second harmonic components at the source plane.

34. (New) A method according to Claim 32, wherein said sample causes defocusing effects in said near field, and because of said relatively large gains in growth of the amplitudes of the second harmonic components between the near field and the focal plane, only a fraction of said second harmonic components are defocused by said near field defocusing effects.

35. (New) A method according to Claim 30, wherein:

the generating step includes the step of using a phased array transducer-receiver unit to generate the transmit signals; and

the directing step includes the steps of

i) using the transducer-receiver unit to focus the transmit signals on a focal point in the sample, and

ii) using electrical circuitry in the transducer-receiver unit to move the focal point around the sample.

36. (New) A system for imaging a biological sample, comprising:

means for generating a transmit ultrasonic signal at a fundamental frequency;

means for directing the transmit signal into and along a propagation path in the sample, wherein the sample distorts the transmit signal along the propagation path and thereby produces a distorted ultrasonic signal including harmonic components at second and higher order harmonic frequencies of the fundamental frequency, and further wherein the sample also reflects the distorted ultrasonic signal including said harmonic components;

means for receiving the harmonic components of the reflected distorted ultrasonic signal;

an analog-to-digital converter for digitizing the received signal;

a processor to process the digitized signal to produce an image principally from one of the received harmonic components of the reflected distorted ultrasonic signal; and

means for displaying said formed image.

37. (New) A system according to Claim 36, wherein the sample has a near field and a focal plane, and wherein the amplitude of the second harmonic component of the distorted ultrasonic signal exhibits a relatively large gain in growth from low near field values to significant focal plane amplitudes.

38. (New) A system according to Claim 37, wherein the sample has a source plane, and as the transmit signal propagates to the focal plane, the amplitude of said second harmonic component of the produced, distorted signal at half the distance between the source and focal planes is about twice the amplitude of said second harmonic component at the source plane.

39. (New) A system according to Claim 38, wherein said sample causes defocusing effects in said near field, and because of said relatively large gain in growth of the amplitude of the second harmonic component between the near field and the focal plane, only a fraction of said second harmonic component is defocused by said near field defocusing effects.

40. (New) A system according to Claim 36, wherein reflected distorted signal also includes frequency components at the fundamental frequency, and further comprising a high pass filter to remove from the received signal the component thereof at the fundamental frequency.

41. (New) A system according to Claim 40, wherein the high pass filter removes said fundamental frequency component of the received signal before the signal is digitized by the analog-to-digital converter.

42. (New) A system according to Claim 36, wherein:

the generating means includes a phased array transducer-receiver unit to generate the transmit signal; and

the transducer-receiver unit focuses the transmit signal on a focal point in the sample, and includes electrical circuitry to move the focal point around the sample.

43. (New) A system for imaging a biological sample, comprising:

means for generating first and second ultrasonic transmit pulse signals at a fundamental frequency;

means for directing the first and second pulse signals into and along a propagation path in the sample, wherein the sample distorts the first and second pulse signals along the propagation path

and thereby produces, respectively, first and second distorted ultrasonic signals including harmonic components at second and higher order harmonic frequencies of the fundamental frequency, and further wherein the sample also reflects the first and second distorted ultrasonic signals including said harmonic components therein;

means for receiving the harmonic components of the reflected first and second distorted ultrasonic signals;

an analog-to-digital converter for digitizing the received first and second signals;

processor means for scaling the digital values obtained from the first signal, subtracting the scaled digital values obtained from the first signal from the second signal to produce a resultant signal, and to process said resultant signal to produce an image principally from the received harmonic components of the reflected distorted ultrasonic signals; and

means for displaying said formed image.

44. (New) A system according to Claim 43, wherein the processor means includes a high pass filter to filter the resultant signal, and the processor means transforms the resultant signal to a time domain to obtain an on-axis distortion imaging pulse.

45. (New) A system according to Claim 43, wherein the sample has a near field and a focal plane, and wherein the amplitudes of the second harmonic components of the distorted ultrasonic signals exhibit relatively large gains in growth from low near field values to significant focal plane amplitudes.

46. (New) A system according to Claim 45, wherein the sample has a source plane, and as the transmit pulse signals propagate to the focal plane, the amplitudes of said second harmonic

components of the produced, distorted signals at half the distance between the source and focal planes is about twice the amplitudes of said second harmonic components at the source plane.

47. (New) A system according to Claim 45, wherein said sample causes defocusing effects in said near field, and because of said relatively large gains in growth of the amplitudes of the second harmonic components between the near field and the focal plane, only a fraction of said second harmonic components are defocused by said near field defocusing effects.

48. (New) A system according to Claim 43, wherein:

the generating means includes a phased array transducer-receiver unit to generate the transmit signals; and

the transducer-receiver unit focuses the transmit signals on a focal point in the sample, and includes electrical circuitry to move the focal point around the sample.